# SPEED OF COMPREHENDING SUBMARINE FIRE CONTROL DISPLAYS: III PROCESSING INFORMATION ABOUT "RIGHT" AND "LEFT" - A NOTE ON LEFT-HANDERS

by

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## SUMMARY PAGE

### THE PROBLEM

To examine the ability of left-handed subjects to make quick decisions based on displays containing information about "right" and "left".

### FINDINGS

Left-handed subjects did not show the right-left processing asymmetries characteristic of right-handers, although in all other respects their performance was comparable to that of right-handers. This finding provides limits on the generalizability of earlier research by showing that left-handed subjects have a different, possibly more complex cognitive model for the directions right and left.

### APPLICATION

This study provides evidence of differences between right- and left-handed subjects in their ability to think about space. Such limitations are relevant to tasks like submarine fire control or navigation, where indirect information must be used to derive spatial representations.

## ADMINISTRATIVE INFORMATION

This investigation was conducted as part of Bureau of Medicine and Surgery Research Work Unit MF51.524.004-2002DX5G -- Man as an Information Processor in Submarine and Diving Systems. The present report is Number 5 on this work unit. It was submitted for review on 26 July 1973, approved for publication on 14 September 1973 and designated as NSMRL Report No. 760. This is the third report in a series on Processing Displays. The first report in this series was NSMRL Rpt. 725, August 1972 and the second was NSMRL Rpt. 758, September 1973.

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## ABSTRACT

A simple word-picture verification task using the terms "right" and "left" was run with left-handed subjects. Unlike right-handers, these subjects showed no evidence for asymmetries between "right" and "left", although in all other respects their performance was comparable to right-handed subjects.

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## INTRODUCTION

Olson and Laxar[1] reported a series of investigations which supported the claim that the mental representation of "right" is less complex than that of "left." Their experiments eliminated simple scanning biases as the source of their effects, and suggested rather that asymmetries in the reaction times to simple word-picture displays were due to characteristics of central information processing. These experiments were all run with right-handed Ss, and it would be of interest to know what comparable performance is like with left-handers. The present report provides evidence on this question.

The assumption that "right" is the less complex term is quite plausible for right-handers. Their handedness coincides with cultural and social conventions to make right the natural reference direction in the sagittal plane, just as one can argue that aboveness and forwardness serve as reference directions in the other planes.[1,2] However, the picture is much less clear for left-handers. Three possibilities seem to have equal a priori plausibility: (1) Because left-handers live in an essentially right-handed world, their internal model of space conforms to that of right-handers; (2) Although social and cultural conventions favor right as the reference direction, the left-hander's handedness is the more dominant factor, yielding left as the simpler term; (3) since the criteria leading to (1) and (2) are in conflict, no performance asymmetry comparable to that found with right-handers should emerge. This possibility could signify either the absence of any underlying conceptual asymmetry or conflict between alternative sets of representations.

Method. The design and logic of this experiment were identical to Experiment I in a previous report.[1] On each trial S saw one of four simple word-picture displays in a tachistoscope and decided as quickly as possible whether the word in the center of the display correctly described the side on which a black dot appeared. These displays are shown in Figure 1. S responded by pressing one of two response keys, and the position of "true" and "false" was counterbalanced across Ss. After each trial S was told his reaction time and informed whether or not he was correct. Four blocks of 28 trials each were presented, each display appearing equally often in each block. The first four trials in a block were warm-ups and were not analyzed. The Ss were 16 left-handed civilian and military personnel, 14 males and 2 females.

Results and discussion. Mean latencies were computed for correct responses only for each block by display by S combination, yielding 16 means for each S. Since the performance of the two females did not differ from that of the males, sex of subject was ignored in all of the subsequent analyses. The

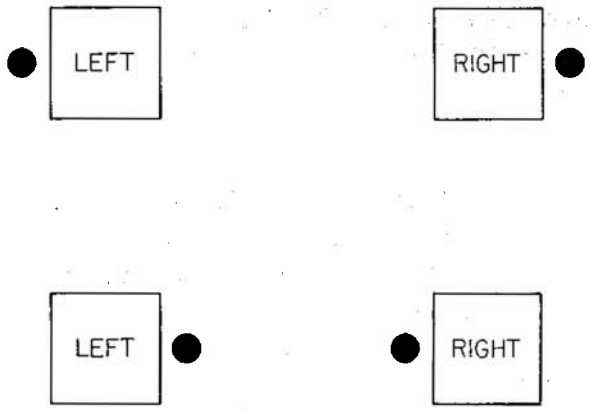


*Fig. 1. Displays used in the experiment.*

mean latencies and error rates for the four displays collapsed over blocks are shown in Figure 2. Comparable data from Experiment I of the previous report are also shown.[1]

A repeated measures analysis of variance of the 256 means for the effects of stimulus word (right-left), dot position (RIGHT-LEFT), and test block (1 through 4) revealed the following significant effects: (1) the interaction of right-left and RIGHT-LEFT was reliable, $F(1,15) = 28.47$, $p < .001$, indicating that Ss responded faster to "true" displays than to "false" ones; (2) Ss became faster as the experiment progressed, $F(3,45) = 13.32$, $p < .001$. The interaction of RIGHT-LEFT with blocks approached significance, $F(3,45) = 2.34$, $.05 < p < .10$. Analysis of errors revealed no significant F-ratios, although the interaction of right-left and RIGHT-LEFT ($F(1,15) = 3.87$, $.05 < p < .10$) and the main effect of blocks ($F(3,45) = 2.41$, $.05 < p < .10$) approached significance.

As in the previous experiments with right-handers, stimulus-response compatibility effects were very strong. These can be summarized as follows. For each S one of the "true" displays referred to the same side as the true response key, and this represented a compatible (C) relationship. The other true display represented an incompatible ($\bar{C}$) relationship. Similarly for the "false" displays. For each S the average difference between the correct reaction times for C and $\bar{C}$ responses ($\bar{C}$ - C) was computed for "true" and "false" responses separately. The mean difference of 171 msec. for "true" responses was significant ($t(15) = 5.52$, $p < .001$), while the difference of -16 msec. for "false" responses was not. An analysis of variance revealed that these S-R compatability effects did not interact with any of the effects revealed by the main analysis.

A comparison of the results for right-handers and left-handers in Figure 2 reveals that their performance is very different. Of the three possibilities listed in the introduction, (3) appears to be supported. The absence of any higher order interactions either in the main analysis or in the secondary analysis for effects of S-R compatibility suggests that within this task there was no consistent pattern of trade-offs between right-normalized and left-normalized spatial models. However, no distinction between the absence of a reference direction or conflicting spatial models can be drawn from our evidence. Since our definition of left-handedness was whether the subject categorized himself as left- or right-handed, perhaps a more sensitive index of handedness or even of lateralization of function might offer greater insight into the left-handers conceptualization of space.

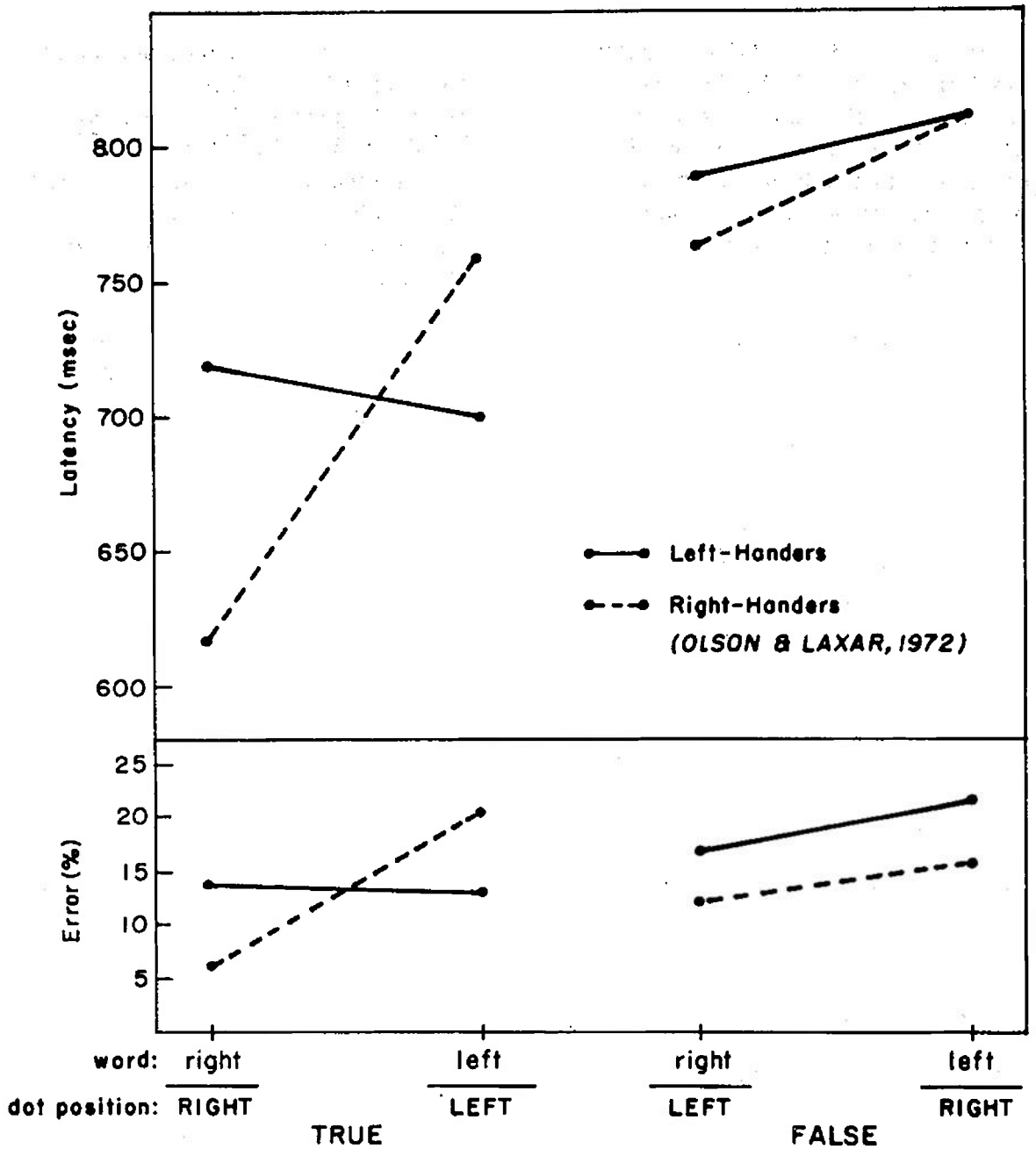


*Fig. 2. Mean reaction times for correct responses and error percentages for right- and left-handed subjects.*

The striking contrast between right-handers and left-handers on this task is consistent with the findings of other investigators. Others have found that the performance of left-handers in tasks requiring spatial abilities is neither parallel to nor complementary to that of right-handers but rather is indeterminate.[3] Disorders of spatial orientation are most acute in the right-left dimension[4,5] and there is evidence that right-left difficulties

are much greater for left-handers.[6,7] These facts along with the data reported here reinforce our earlier view[1] that "the conceptualization of right and left is much more labile, flexible, and subject to disruption than that of the other two spatial dimensions."

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| Choice Reaction Time | | | | | | |
| Spatial Directions | | | | | | |
| S-R Compatibility | | | | | | |
| Handedness | | | | | | |

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